Thermo Fisher SCIENTIFIC

Pharma and biopharma

Solutions for pharmaceutical, medical device extractables and leachables analysis

Enhance your capabilities

Unknown impurity identification and quantification workflows for:

- Pharmaceutical, packaging and contact-closure materials
- Medical devices

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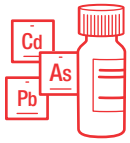


Elemental impurities

ppd

PPD™ Laboratory Services

Services and support

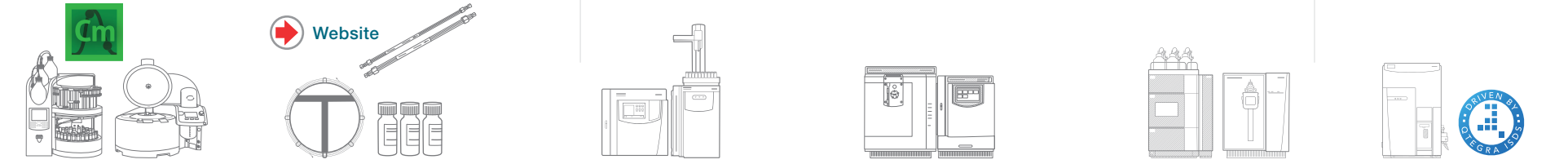
Extractables and leachables background

Extractables and leachables (E&L) studies enable identification, quantification and risk assessment of potentially toxic leachable impurities migrating into a drug from container closure systems, processing equipment drug delivery components or packaging.

The US Food and Drug Administration (FDA) and the European Medicines Agency (EMA) are progressively focusing on the interactions between different manufacturing components including; single use systems (SUS), drug delivery devices and container-closure systems, and the finished drug product.

We offer differentiated solutions to test extractables in single use systems, container materials, medical devices, and other consumables used in pharmaceutical production, such as stoppers, o-rings, bags, tubings, filters that are commonly used in manufacturing process and may introduce leachables into the final drug product.

Extractables and leachables workflows



ASE and automated, fast evaporation to achieve up to 200x concentration effect.

Thermo Scientific™ SureSTART™ vials, UHPLC and GC columns and ultrapure solvents.

Thermo Scientific™ TriPlus™ 500 GC for headspace sampling and complaint GC/MS.

Untargeted screening with the Thermo Scientific™ Orbitrap™ Exploris™ GC Mass Spectrometer.

Thermo Scientific™ Orbitrap™ MS with high-resolution, accurate-mass (HRAM) technology with charged aerosol detection.

Robust and sensitive Thermo Scientific™ iCAP™ MX Series ICP-MS.

Extractables and leachables website

Everything you need to know about extractables and leachables

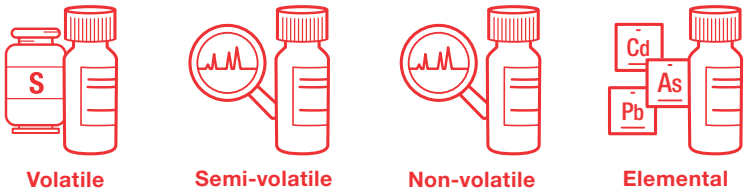
Website Extractables and leachables learning center

Pharmaceutical contact-closure materials

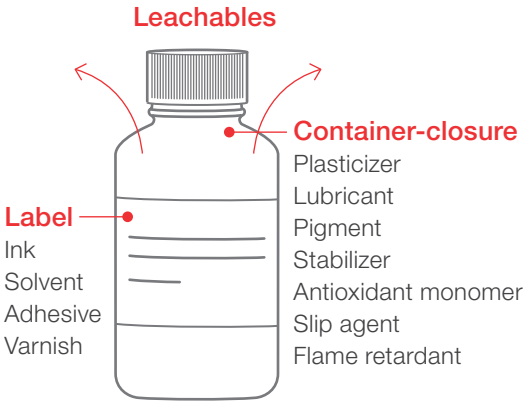
Extractables and leachables compounds and elements can migrate from polymeric materials used in container closure, production, delivery and packaging systems for pharmaceuticals and biopharmaceuticals.

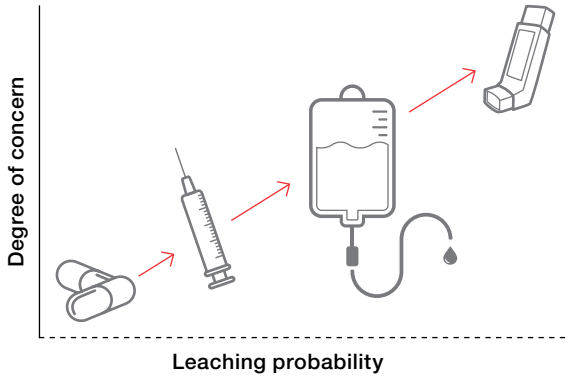
Extractables migrate from container materials when exposed under laboratory conditions to solvents under exaggerated temperature and time environments.

Leachables are chemical species that migrate into the product under normal storage or use conditions.



Volatile | Semi-volatile | Non-volatile | Elemental





Quantification

These challenges require an arsenal of analytical techniques and workflows to meet the ever demanding challenges of compliance with global regulations.

Regulations and methods

USP <381>	USP <1663>	PQRI Guidelines
USP <660>	USP <1664>	ASTM F 1980-07
USP <661>	USP <1665>	BPOG Guidelines
USP <665>	ISO 10993	ICH Q3

Medical devices

A medical device, according to the US Food and Drug Administration (FDA), is an instrument, apparatus, implement, machine, contrivance, implant, in vitro reagent, or other similar or related article, including a component part, or accessory which is:

- Recognized in the official National Formulary or USP
- Intended to be used in the diagnosis of disease, medical conditions, treatment of disease
- Intended to affect the structure or any function of the body of man or other animals, and which does not achieve any of its primary intended purposes through chemical action within or on the body

Confident identification

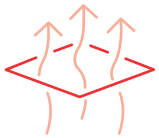
The analysis of medical devices involve a diverse range of chemicals; from volatiles to high molecular weight non-volatile molecules and even metals.

Regulations

Extractables Study (ISO 10993-18)
Leachables/Simulation study
Cytotoxicity test of leachables (ISO 10993-5)
Sensitization test of leachables (ISO 10993-10)
Article IX of the EU Council Directive 93/42/EEC

Factors affecting migration

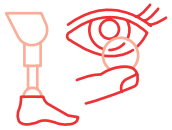
Matrix type
Blood, saliva, saline solutions, drug product solutions etc.



Heat
Higher temperatures increase leaching.

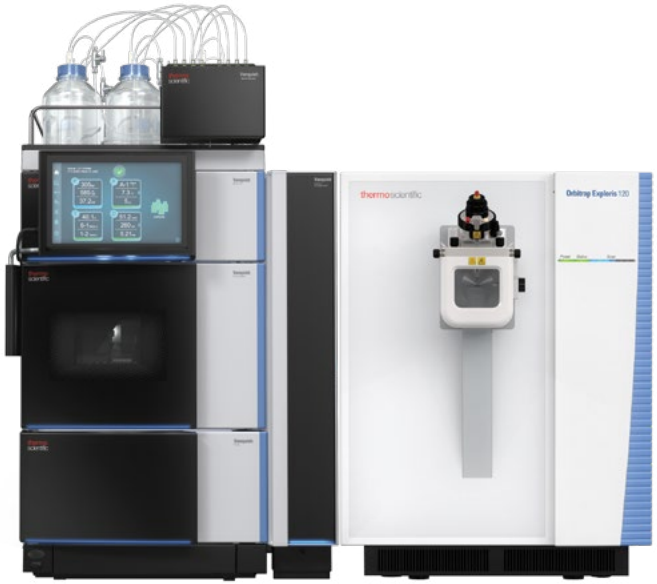
Time
Long exposure time increases risk for leaching.

Medical device type
Certain devices can leach more compounds such as implants and prostheses compared to others.



Size
Smaller devices leach more due to higher surface area to volume ratio.

Per- and polyfluoroalkyl substances (PFAS)



Thermo Scientific™ Vanquish™ UHPLC system

Thermo Scientific™ Orbitrap Exploris™ 120 mass spectrometer

Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS)

PFAS risks in pharmaceuticals

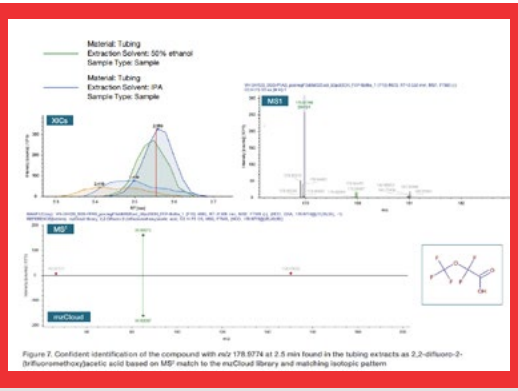
PFAS (per- and polyfluoroalkyl substances) are persistent chemicals linked to serious health risks. PFAS are used extensively in pharmaceutical manufacturing for various applications, including active pharmaceutical ingredients (APIs), manufacturing processes, and packaging materials. While their unique properties are valuable, PFAS are also persistent in the environment and have been linked to health concerns. Regulatory scrutiny is increasing, and the pharmaceutical industry is navigating challenges related to PFAS restrictions.

Pharmaceutical companies should take a proactive approach to monitor PFAS levels in raw materials and finished products to help reduce risk, avoid recalls, and ensure compliance with evolving standards.

Per- and polyfluoroalkyl substances (PFAS)

Our PFAS testing solution combines targeted quantitation and non-targeted screening from a single LC-MS injection, enabling both precise identification of known PFAS compounds down to sub-ppb levels and the discovery of unknown contaminants using surrogate standards. Background interference is minimized using a PFAS-specific analysis kit and delay column, increasing confidence in results. With Thermo Scientific™ Chromeleon™ CDS, data acquisition and analysis are streamlined in a 21 CFR Part 11-compliant environment. This comprehensive approach helps pharmaceutical companies stay ahead of evolving regulations and avoid costly delays or recalls.

Figure 1. Overview of the LC-MS analytical strategy for detection of targeted and non-targeted PFAS as part of E&L analysis of pharmaceutical packaging and processing material extracts



This high-resolution LC-MS method, using polarity switching Full Scan-ddMS² and Orbitrap detection, enables accurate identification of both known and unknown PFAS in pharmaceutical materials. With LOQs down to 0.1 ppb for 17 PFAS compounds, and minimal background interference thanks to the PFAS analysis kit and delay column, the workflow ensures reliable results. It also improves detection of common LC-MS extractables, making it a powerful solution for pharmaceutical manufacturers aiming to meet evolving PFAS regulations and ensure product safety in a compliant, efficient process.

Extract smarter

Traditional Soxhlet or reflux techniques recommended by PQRI and BPOG are labor intensive (>24 hours) and consume a large quantities of solvent (>150 mL/sample).

Accelerated solvent extraction delivered by the Thermo Scientific™ Dionex™ ASE™ 350 system is an automated alternative with several advantages, including efficient extraction, reduced extraction time (<0.5 h/sample) and reduced solvent use (<30 mL/sample).

Conditions can be carefully controlled to ensure that the material is not deformed or damaged during the extraction process.

The ASE technique delivers comparable or more efficient extractions than the traditional Soxhlet methods; while saving time and solvent and delivering confidence through control by compliance-ready Chromeleon software.

Thermo Scientific™ Rocket™ Evaporator

Brochure

Extractables and leachables

Thermo Scientific™ Dionex™ ASE™ 350 Accelerated Solvent Extractor Systems
Use less bench space, extract up to 10 times faster, and use less solvent with ASE extraction.

Website Brochure

Volatiles

Low molecular weight, polar and non-polar organic compounds are typically volatile and have the highest probability to migrate from or through polymeric contact closure systems.

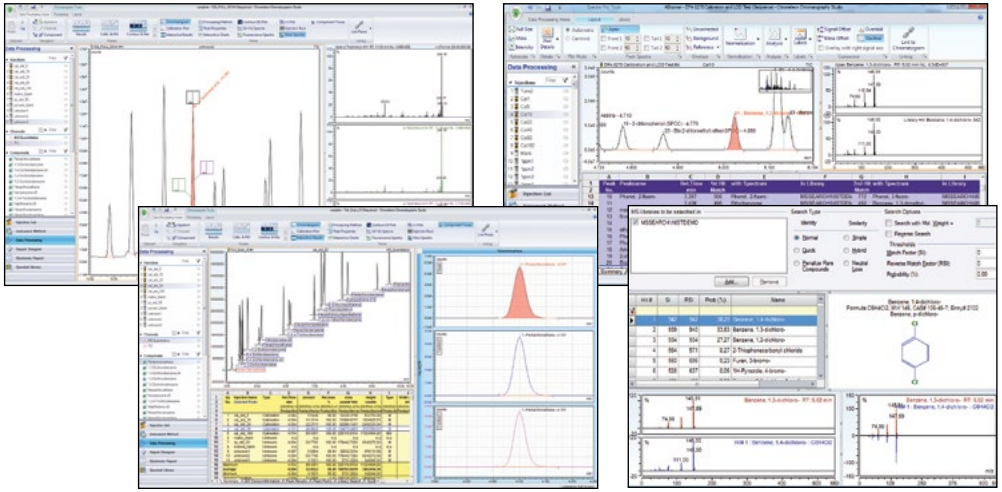
Thermo Scientific™ ISQ™ 7610 single quadrupole GC-MS

Thermo Scientific™ TRACE™ 1600 series Gas Chromatograph

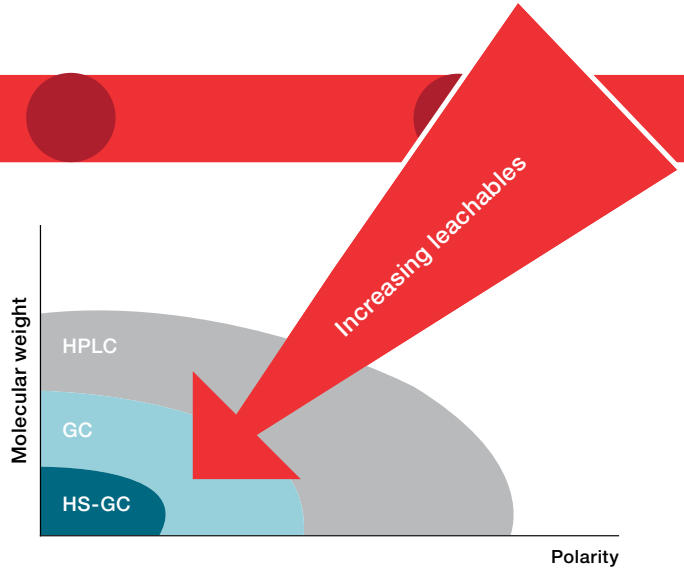
Thermo Scientific™ TriPlus™ 500 Headspace Autosampler

No more volatile unknowns

In many extractables and leachables laboratories, sample preparation often accounts for more than twice the time spent on actual chromatography. Improved sample handling can reduce turnaround times and significantly lower the cost per analysis. Automate and accelerate organic volatiles determinations, to increase sample turnaround and lower the cost per analysis, with the powerful Thermo Scientific™ TriPlus™ 500 headspace autosampler.



Qualitative and quantitative GC-MS with full 21 CFR 11 compliance



Low molecular weight, polar and non-polar organic compounds are typically volatile and have the highest probability to migrate from or through polymeric contact closure systems.

Testing of the contact closure material is typically conducted by headspace sampling followed by gas chromatography and mass spectrometry.

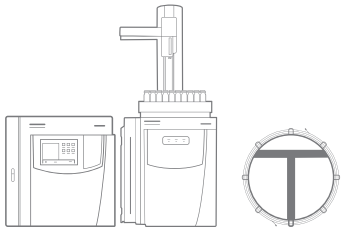
Volatile organic impurities and residual solvents

Volatile organic impurities and residual solvents website
Everything you need to know about volatile organic impurities in one place.

Website

Autosampler vials
Ultraclean SureSTART headspace vials ensure low background and leak free seals.

Website



Thermo Scientific™ TRACE™ 1600 Gas Chromatography
Reliable and robust GC quantification.

Website Brochure

Thermo Scientific™ TriPlus™ 500 Headspace Autosampler
Automated headspace sampling for pharmaceutical residual solvent analysis.

Website Brochure

Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS)
Compliant and intuitive CDS for GC and GC-MS.

Website

Brochure

Thermo Scientific™ Compound Discoverer™ Software
Advanced software for identification of unknowns.

Website

Brochure

Semi-volatiles

Semi-volatile compounds are among the most frequently detected migration impurities. Testing is performed through liquid injection of an extract of the material or product. Often extracts are derivatized to increase analyte volatility. Testing demands absolute confidence in unknown identification and quantification.

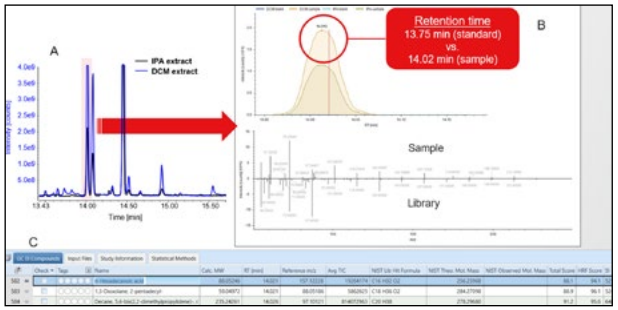
Thermo Scientific™ TSQ™ 9610 GC-MS/MS system coupled with Thermo Scientific™ TRACE™ 1610 Gas Chromatograph

Targeted screening

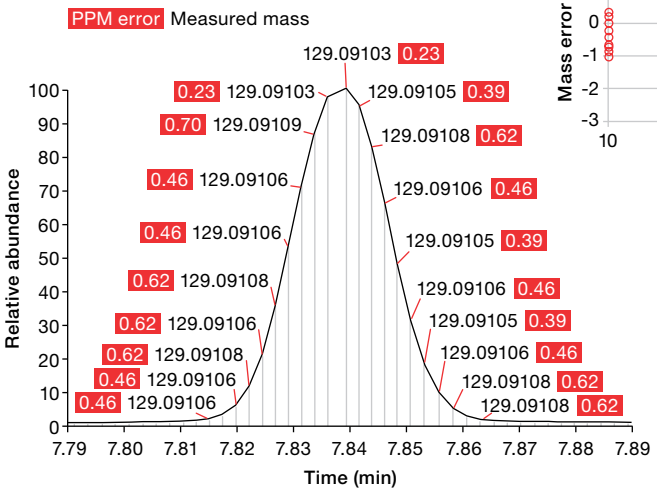
Best-in-class system for ultimate sensitivity and quantitation of targeted compounds. Optimized for high-throughput analytical laboratories

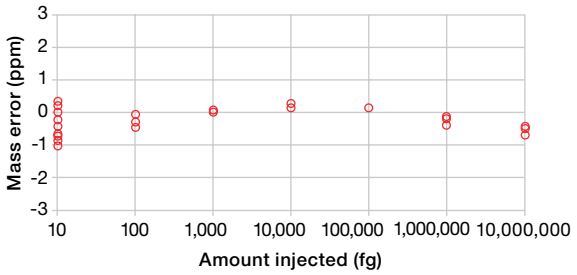
Orbitrap comes to GC-MS

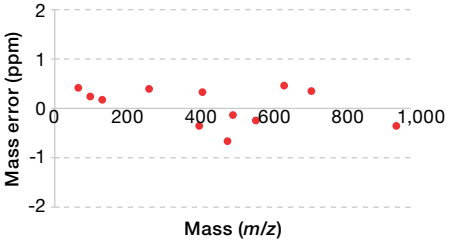
The Thermo Scientific™ Orbitrap™ Exploris™ GC 240 Mass Spectrometer system provides comprehensive characterization of samples in a single analysis for the highest confidence in compound discovery, identification, and quantitation. This system offers the quantitative power of a GC triple quadrupole MS combined with the high precision, full scan HR/AM capabilities only available in combination with Thermo Scientific™ Orbitrap™ technology.



Deconvolute, identity and quantify







Exceptional <1 ppm mass accuracy is achieved on every scan, on every mass, and at every concentration.

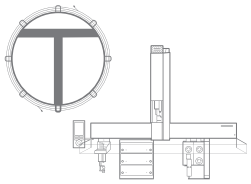
Semi-volatile organic impurities

Semi-volatile organic impurities website
Everything you need to know about semi-volatile organic impurities.

Website

Ultra clean Thermo Scientific™ MS Certified vials
Ensure the lowest backgrounds to reduce false positives.

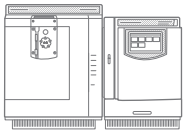
Website



Sample preparation and consumables
Thermo Scientific™ TraceGOLD™ GC columns and Thermo Scientific™ TriPlus™ RSH Autosampler.

GC columns website

TriPlus website



Thermo Scientific™ Orbitrap™ Exploris™ GC or LC Mass Spectrometer
Fast, unambiguous identification and quantification of semi-volatile organic impurities using GC or LC HRAM-MS.

GC HRAM website

LC HRAM website

Thermo Scientific™ Chromeleon™ Chromatography Data System (CDS)
Compliant and intuitive software solution for HRAM GC-MS.

Website

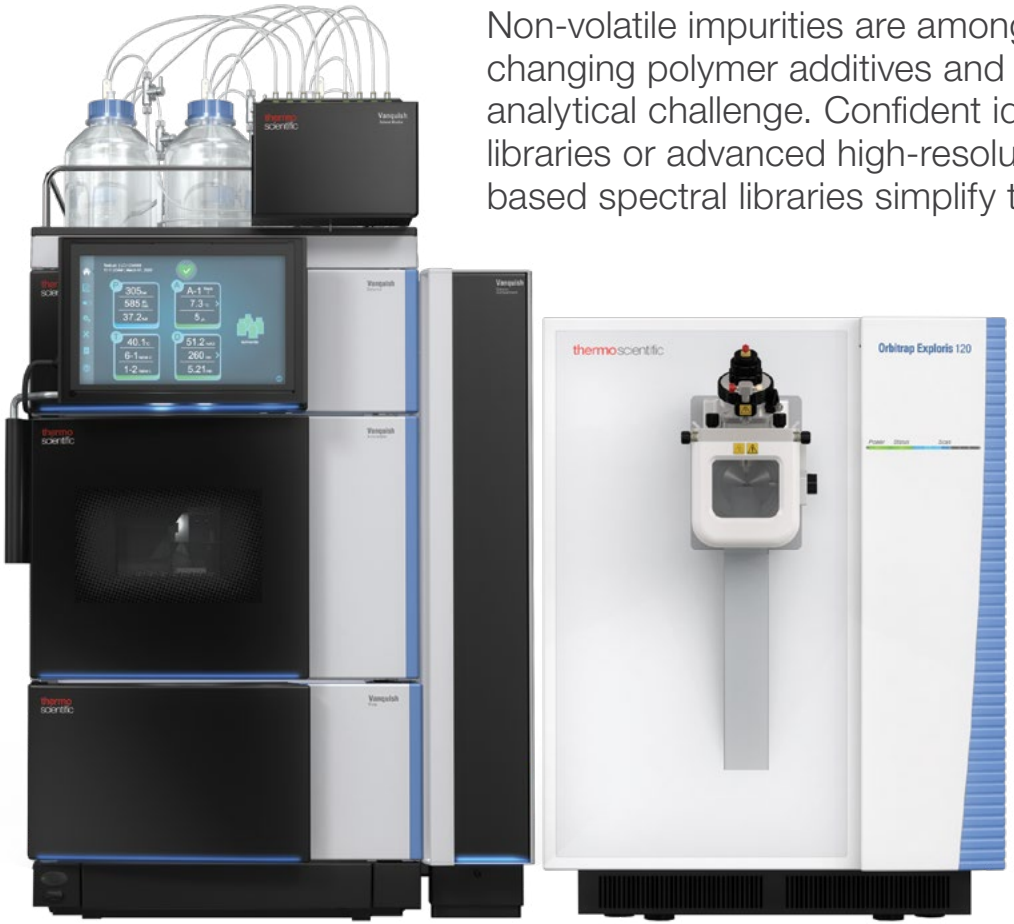
Brochure

Thermo Scientific™ Compound Discoverer™ Software
Advanced software for identification of unknowns.

Website

Brochure

Non-volatiles



Thermo Scientific™ Vanquish™ Core HPLC system coupled with Thermo Scientific™ Orbitrap Exploris™ 120 mass spectrometer

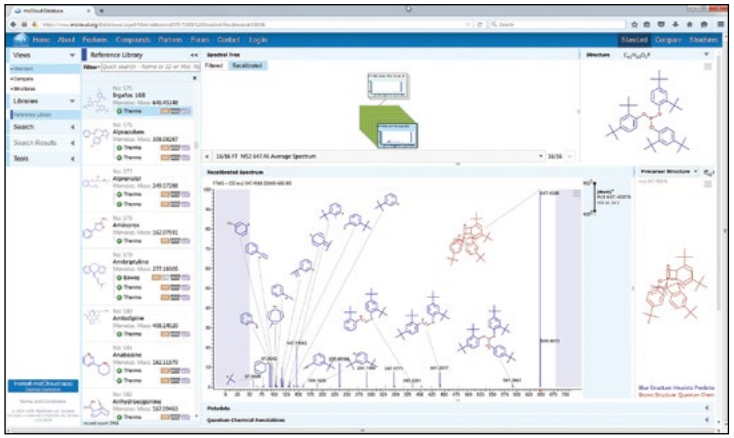
Non-volatile impurities are among the most difficult to identify. Ever-changing polymer additives and monomers represent an ongoing analytical challenge. Confident identification using a range of targeted libraries or advanced high-resolution accurate-mass (HRAM) cloud based spectral libraries simplify the workflow.

Proven performance for extractables

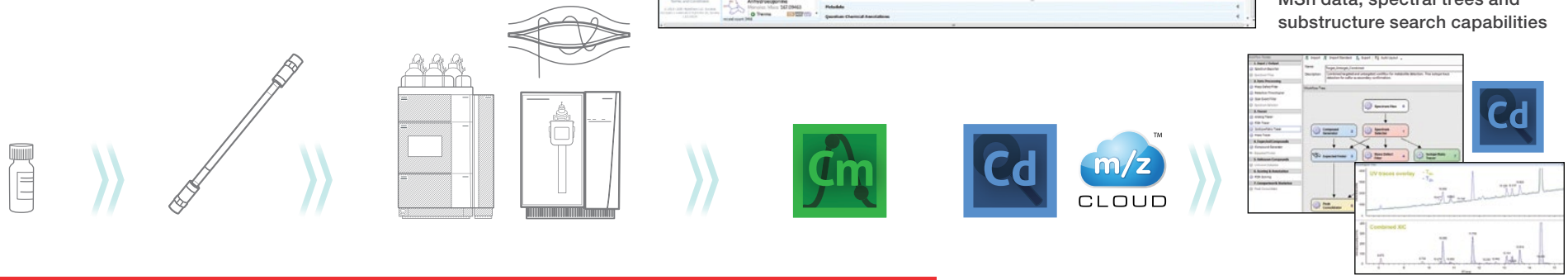
Identify and confirm more compounds rapidly and with confidence using the Thermo Scientific™ Orbitrap™ Exploris™ Hybrid Quadrupole-Orbitrap mass spectrometer and Thermo Scientific™ Vanquish™ UHPLC system.

Proven performance for extractables

This benchtop LC-MS/MS system combines industry leading chromatography with quadrupole precursor ion selection and high-resolution, accurate-mass Orbitrap detection to deliver exceptional performance and versatility.



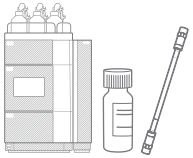
Search spectra on-line with mzCloud,™ a free to search online HRAM mass spectral library. mzCloud also contains full spectral annotation with MSn data, spectral trees and substructure search capabilities



Non-volatile organic impurities

Non-volatile organic impurities website
Everything you need to know about non-volatile organic impurities.

Website

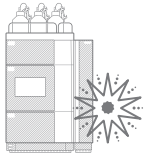


Thermo Scientific™ Vanquish™ UHPLC systems, columns and vials
Ensure the best LC separation.

HPLC/UHPLC product tour

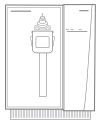
LC columns

SureSTART vials/caps



Vanquish Charged Aerosol Detectors
See everything with near-universal CAD detectors.

Learning center



Thermo Scientific™ Orbitrap Exploris™ Mass Spectrometers
Qualitative and quantiative confidence with HRAM LC-MS.

Website

Thermo Scientific™ Compound Discoverer™ Software
Advanced software for identification of unknowns.

Website

mzCloud™ mass spectral library
A free to search online high resolution mass spectral library.

Website

Thermo Scientific™ Compound Discoverer™ software ensures confident compound identification and structural elucidation with advanced algorithms that quickly process and identify changes between different sample groups and identify compounds based on multiple search approaches; including matching against HRAM libraries like mzCloud™ and compound databases. Searches are conducted in parallel and a single unified report is delivered.

Combining information from multiple detectors increases the confidence that all components in a study are found. Here data from DAD and HRAM mass spectrometry are combined.

Elemental impurities

Elemental impurities are common in printed materials, pigments, foil based packaging and delivery systems. Elemental impurities are analyzed following the International Council on Harmonization (ICH) guideline Q3D or U.S. Pharmacopeial convention (USP) <232> and <233> guidelines.

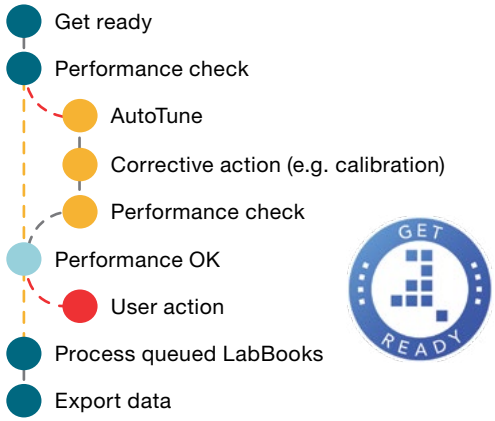
Robust, compliant analysis at the lowest levels is provided by Thermo Scientific™ iCAP™ MX series ICP-MS.

Simplicity, productivity, robustness

Gain complete confidence with accurate results. Enjoy minimal maintenance thanks to our intelligently engineered design. The Thermo Scientific™ iCAP™ MX ICP-MS has the analytical performance to comfortably meet the most challenging pharmaceutical regulatory requirements for elemental impurities, including limits from the International Council for Harmonisation (ICH) guideline Q3D and the USP chapters <232>, <233> and <2232>.

Automate more

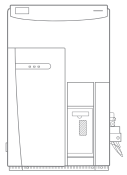
Your time is precious. Spend less time at the instrument by using automated, unattended system set-up routines like the advanced single-click ‘Get Ready’ function in Thermo Scientific™ Qtegra™ Intelligent Scientific Data Solution™ (ISDS) software.



Elemental impurities

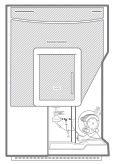
Elemental impurities website
Everything you need to know about elemental impurities in one place.

Website



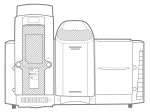
Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
Expand your analytical capabilities with this complete trace elemental analysis solution for your high-throughput compliant lab with ICP-MS.

Website



Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES)
Robust, fit-for-purpose, compliant ICP-OES.

Website

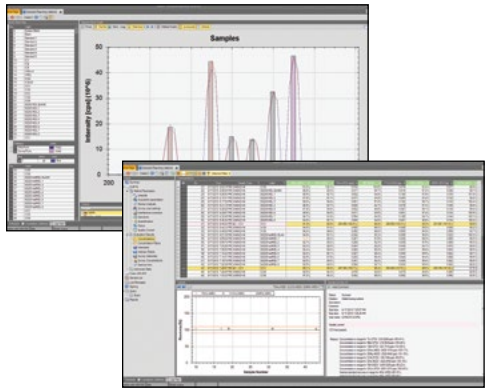


Atomic Absorption (AA) Spectroscopy
Cost-effective, simple, compliant AA.

Website

Designed to comply with the most rigorous data audit and security measures, Qtegra ISDS software is FDA 21 CFR Part 11 ready and comes with full IQ/OQ procedures for simple implementation in GMP/GLP regulated environments.

Website



With a clean, logical workflow, Qtegra ISDS software displays QC results in a LabBook. Full isotopic mass spectra are retained in the LabBook for further interrogation post analysis.

ppd

PPD™ Laboratory Services, GMP Lab

Extractables and leachables services

Extractables and leachables testing solutions

Nitrosamines testing solution

PPD is a leading global contract research organization focused on delivering life-changing therapies

GMP Lab Capabilities | PPD

GMP Laboratory Services | PPD

Contact PPD Laboratories | PPD

Quality consumables you can rely on for dependable results

Liquid chromatography

With over 40 years as a leader in LC column technology, the Thermo Scientific™ HPLC and UHPLC family of products offers a variety of particle sizes and column designs to meet all separation needs, including improved resolution, enhanced sensitivity, faster analysis and consistent performance.

- Reversed-phase columns
- Normal phase columns
- HILIC columns
- Mixed-mode columns
- Ion-exchange columns
- Size-exclusion columns
- Application specific columns

View related information

Gas chromatography

Our columns represent a leap forward in performance, delivering low bleed and superior inertness. Select from our comprehensive portfolio of Thermo Scientific GC columns that meet all of your analytical needs and achieve reliable, reproducible results.

- Application specific columns
- Non-polar GC columns
- Low-polar GC columns
- Mid-polar GC columns
- Polar GC columns
- PLOT GC columns
- Ultrafast GC columns

View related information

Vials and closures

Autosampler vials and compatible inserts, septa, and closures designed for chromatography applications. Products come in various dimensions, material compositions, volume capacities, closure types, and colors. Products are available as individual components or kits.

- Screw top vials and kits
- Crimp top vials and kits
- Head space vials and kits
- Certified vial kits
- Micro vials and inserts
- 96 and 384 well plates
- Electronic crimpers and decrimpers
- Manual crimpers and decrimpers

View related information

Services and support

Unity™ Lab Services provides world-class service solutions to support your instruments. Our comprehensive service portfolio was designed to meet the needs of your lab.

- Instrument service plans
- On-demand services
  - Compliance services
  - Preventive maintenance
  - Installation
- Education

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Learn more at **thermofisher.com/extractablesandleachables**